IN THE CLAIMS

What is claimed is:

1. A semiconductor device, comprising:

a wiring structure in which an upper surface of a wiring made of a copper containing film is covered with an insulation film, wherein a barrier film is formed covering the upper surface of the wiring and between the wiring and a cap film for preventing copper diffusion.

2. The semiconductor device of claim 1, wherein:

the barrier film is an exposure prevention film which prevents the wiring from being exposed to a film forming gas for the cap film.

3. The semiconductor device of claim 1, wherein:

the cap film includes an SiCN film.

4. The semiconductor device of claim 3, wherein:

the SiCN film is a film formed with a trimethylsilane gas, NH_3 gas, and a third gas, the third gas being selected from the group consisting of helium gas (He), nitrogen gas (N_2), and argon gas (Ar).

5. The semiconductor device of claim 1, wherein:

the barrier film is a film formed without using NH_3 gas.

6. The semiconductor device of claim 5, wherein:

the barrier film includes a SiC film.

7. The semiconductor device of claim 1, further including:

a multilayer wiring structure including a plurality of wiring layers made of a copper containing film, with each wiring layer separated by a respective interlayer insulation film.

8. A method of producing a semiconductor device having a wiring structure in which an upper surface of a wiring made of copper or a copper alloy is covered with an insulation film, comprising the step of:

forming a cap film, for prevention of copper diffusion, between the wiring and the insulation film, and over a barrier film covering the upper surface of the wiring.

9. The method of producing the semiconductor device of claim 8, further including:

a step of forming the barrier film without using a NH_3 gas after the wiring film is formed.

10. The method of producing the semiconductor device of claim 8, wherein:

the barrier film includes an SiC film.

11. The method of producing the semiconductor device of claim 8, wherein:

the step of forming the cap film includes using a trimethylsilane gas, NH_3 gas, and third gas after the barrier film is formed, the third gas being selected from the group consisting of helium gas (He), nitrogen gas (N_2), and argon gas (Ar).

12. The method of producing the semiconductor device of claim 11, wherein:

the cap film is formed by introducing the NH_3 gas after the barrier film is formed by using the trimethylsilane gas and the third gas.

13. The method of producing the semiconductor device of claim 11, wherein:

the cap film includes a SiCN film.

14. The method of producing the semiconductor device of claim 8, wherein the barrier film and the cap film are formed after the wiring is formed and further including the steps of:

a series of processes for forming layers of wirings, each layer of wiring covered by an interlayer insulation film and including a step of forming a cap film, for prevention of copper diffusion, over a barrier film covering an upper surface of the layer of wiring.

15. A method of producing a semiconductor device, including the steps of:

forming a first wiring layer made of a copper containing film within a first interlayer insulation film;

forming a first barrier film over an upper surface of the first wiring

layer;

forming a first cap film for preventing copper diffusion over the first barrier film; and

forming a second interlayer insulation film over the first cap film.

16. The method of producing the semiconductor device of claim 15, wherein:

the step of forming the first barrier film does not include using a NH_3 gas.

17. The method of producing the semiconductor device of claim 15, wherein:

the first barrier film includes a SiC film; and

the first cap film includes a SiCN film.

18. The method of producing the semiconductor device of claim 15, wherein:

the step of forming the first cap film includes using a trimethylsilane gas, NH_3 gas, and a third gas after the first barrier film is formed, the third gas being selected from the group consisting of helium gas (He), nitrogen gas (N_2), and argon gas (Ar).

19. The method of producing the semiconductor device of claim 18, wherein:

the first cap film is formed by introducing the NH_3 gas after the first barrier film is formed by using the trimethylsilane gas and the third gas.

20. The method of producing the semiconductor device of claim 15, further including the steps of:

forming a second wiring layer made of a copper containing film within a third interlayer insulation film over the second interlayer insulation film;

forming a second barrier film over an upper surface of the second wiring layer; and

forming a second cap film for preventing copper diffusion over the second barrier film.